

**GENERAL CERTIFICATE OF SECONDARY EDUCATION**

**GATEWAY SCIENCE**

**B742/01**

**CHEMISTRY B**

Unit B742: Chemistry modules C4, C5, C6 (Foundation Tier)

**MARK SCHEME**

**Duration:** 1 hour 30 minutes

**MAXIMUM MARK      85**

**Guidance for Examiners**

Additional Guidance within any mark scheme takes precedence over the following guidance.

1. Mark strictly to the mark scheme.
2. Make no deductions for wrong work after an acceptable answer unless the mark scheme says otherwise.
3. Accept any clear, unambiguous response which is correct, eg mis-spellings if phonetically correct (but check additional guidance).
4. Abbreviations, annotations and conventions used in the detailed mark scheme:

/ = alternative and acceptable answers for the same marking point

(1) = separates marking points

**not/reject** = answers which are not worthy of credit

**ignore** = statements which are irrelevant - applies to neutral answers

**allow/accept** = answers that can be accepted

(words) = words which are not essential to gain credit

words = underlined words must be present in answer to score a mark

ecf = error carried forward

AW/owtte = alternative wording

ora = or reverse argument

Eg mark scheme shows 'work done in lifting / (change in) gravitational potential energy' (1)

work done = 0 marks

work done lifting = 1 mark

change in potential energy = 0 marks

gravitational potential energy = 1 mark


5. If a candidate alters his/her response, examiners should accept the alteration.
6. Crossed out answers should be considered only if no other response has been made. When marking crossed out responses, accept correct answers which are clear and unambiguous.

Question		Expected answers	Marks	Additional guidance
1	(a)	magnesium (1)	1	
	(b)	iodine (1)	1	
	(c)	nitrogen (1)	1	
		<b>Total</b>	<b>3</b>	

Question		Expected answers	Marks	Additional guidance
2	(a)	because carbon dioxide (gas) is given off (1)	1	
	(b)	because when heated it breaks down / when heated one substance makes at least two substances / when heated changed into simpler substances (1)	1	
	(c)	cobalt carbonate → cobalt oxide + carbon dioxide (1)	1	<b>allow</b> $\text{CoCO}_3 \rightarrow \text{CoO} + \text{CO}_2$
	(d)	iron(III) carbonate because $-25^\circ\text{C}$ is less than room temperature / AW (1)	1	<b>allow</b> iron(III) carbonate because you have to cool it to get to $-25^\circ\text{C}$ (1)
		<b>Total</b>	<b>4</b>	

Question		Expected answers	Marks	Additional guidance
3	(a)	negative (1)	1	if answer line is blank allow correct answer circled, underlined or ticked
	(b)	because the protons are positive (and the neutrons are neutral) (1)	1	<b>allow</b> because there are no negatively charged electrons in the nucleus only positive protons and neutral neutrons (1)
	(c)	atomic number is 5 because nucleus has 5 protons (1) mass number is 11 because there are 11 particles in the nucleus (1)	2	<b>allow</b> mass number is 11 because there are 5 protons and 6 neutrons (1)
	(d)	they told others through: use of conferences / use of books / use of journals (1) telling others allowed: peer review by other scientists / evaluation / checking of their work / repeating of their experiments by other scientists / other scientists to develop their work (1)	2	<b>allow</b> they publish their results (1) <b>ignore</b> telephone / internet / television / video
		<b>Total</b>	<b>6</b>	

Question		Expected answers	Marks	Additional guidance
4	(a)	<p><b>any two from</b>  stops reaction with water / stops reaction with moisture (1)  stops reaction with air / oxygen (1)  very reactive metal / stops it corroding / AW (1)</p>	2	<b>allow</b> stops reaction with moist air (2)
	(b)	$2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2$ correct formulae (1) correct balancing (1)	2	<b>allow</b> = sign for arrow <b>not</b> and or & for +
	(c)	<p>melting point and atomic radius have steady trends so you can predict the next value but density does not have a steady trend so you cannot predict if next number is higher or lower (2)</p> <p><b>OR</b></p> <p>melting point decreases and atomic radius increases / density does not have a trend (1)</p>	2	<p><b>allow</b> description of trends for melting point and atomic radius instead of general statements eg melting point decreases steadily and atomic radius increases steadily  <b>allow</b> use of term pattern instead of trend</p> <p><b>if answer does not compare melting point and atomic radius with density then limited to 1 mark</b></p>
		<b>Total</b>	<b>6</b>	

Question	Expected answers	Marks	Additional guidance
<p>5</p> 	<p><b>Level 3</b>                      Four properties of titanium predicted with a clear rationale linked to titanium being a transition metal. Applies knowledge of properties to relate them to the use of titanium in aeroplane wings. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling.                      (5–6 marks)</p> <p><b>Level 2</b>                      Some properties of titanium predicted with an attempt at an explanation for the choice of these properties or their relevance to use in an aeroplane. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling.                      (3–4 marks)</p> <p><b>Level 1</b>                      Identification of titanium as a metal and at least two correct properties but no reasons given. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science.                      (1–2 marks)</p> <p><b>Level 0</b>                      Insufficient or irrelevant science. Answer not worthy of credit.                      (0 marks)</p>	<p>6</p>	<p><b>relevant points include:</b></p> <ul style="list-style-type: none"> <li>• identification of titanium as a metal</li> <li>• identification as a transition element using its position in the Periodic table</li> <li>• link that transition elements are metals</li> </ul> <p>• physical properties – hard, good thermal conductor, good electrical conductor, lustrous, sonorous, high melting point, high boiling point, high tensile strength</p> <p>examples of relating properties to use in aeroplanes</p> <ul style="list-style-type: none"> <li>• idea of low density since it is used for an aeroplane and will require less force to lift</li> <li>• idea of strong to be able to be used as a wing so can withstand forces</li> <li>• idea of malleable so it can be made into sheets</li> </ul> <p><b>allow</b> does not react with water / does not rust</p> <p><b>ignore</b> solid / colour of metal / heavy / light</p> <p><b>not</b> properties opposite to list above / magnetic</p>
	<p><b>Total</b></p>	<p>6</p>	

Question		Expected answers	Marks	Additional guidance
6	(a)	41.6(1)	1	unit <b>not</b> needed answer on answer line takes precedence
	(b)	2000 (1)	1	unit <b>not</b> needed
		<b>Total</b>	<b>2</b>	


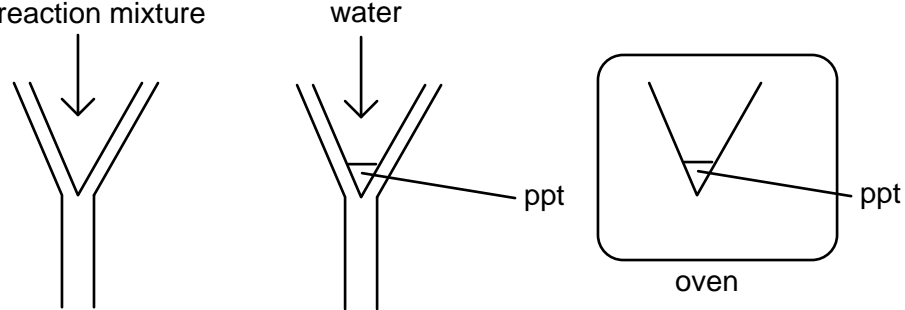
Question		Expected answers	Marks	Additional guidance
7	(a)	X is sulfur (1) Y is air (1)  water is good because it is readily available / very cheap (1)	3	<b>allow</b> X is S <b>allow</b> one mark if X is air and Y is sulfur <b>allow</b> correct answers written on flow chart if answer lines are blank  <b>allow</b> water is free
	(b)	sulfur trioxide (1)	1	<b>allow</b> SO <sub>3</sub> <b>ignore</b> sulfur oxide
		<b>Total</b>	<b>4</b>	

Question		Expected answers	Marks	Additional guidance
8	(a)	pipette (1)	1	<b>allow</b> measuring cylinder
	(b)	indicator suddenly changes colour (1) from blue or purple in alkali to red or pink (1)	2	<b>both colours needed</b>
	(c)	calculated titres for 2 and 3 as 21.1 and 19.9 (1) mean titre = 20.0 (1)	2	titres can be in text or in the table unit <b>not</b> needed but must be correct if quoted answer must be to <b>one</b> decimal place
	(d)	<b>B</b> because the least amount of acid is used to neutralise the alkali (1)	1	
		<b>Total</b>	<b>6</b>	

Question		Expected answers	Marks	Additional guidance
9	(a)	166 (1)	1	<b>ignore units</b>
	(b)	C <sub>2</sub> H <sub>2</sub> and C <sub>6</sub> H <sub>6</sub> (1)	1	<b>both needed</b>
		<b>Total</b>	<b>2</b>	



Question	Expected answers	Marks	Additional guidance
10	<p><b>Level 3</b> Applies understanding of weak and strong acids to describe in detail both a similarity and a difference which are explained in terms of hydrogen ions and collision theory. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5-6 marks)</p> <p><b>Level 2</b> Applies knowledge of weak and strong acids to describe that both acids make carbon dioxide and the nitric acid reaction is faster. Explanation that involves the use of collision theory although not in terms of hydrogen ions specifically. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3-4 marks)</p> <p><b>Level 1</b> Describes that both acids make a gas (if named the gas is carbon dioxide) and that the nitric acid reaction is faster. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1-2 marks)</p> <p><b>Level 0</b> Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)</p>	6	<p><b>relevant points include</b></p> <p><u>description</u></p> <ul style="list-style-type: none"> <li>• both acids make carbon dioxide and water</li> <li>• same volume / amount of carbon dioxide made</li> </ul> <p>• nitric acid has a faster reaction / ora</p> <ul style="list-style-type: none"> <li>• reaction with nitric acid finishes before one minute</li> </ul> <p><u>explanation</u></p> <ul style="list-style-type: none"> <li>• both contain hydrogen ions which react with calcium carbonate to give carbon dioxide (and water)</li> <li>• same amount of acid / same volume and concentration of acid / same number of moles used in both cases so both make same volume or amount of carbon dioxide</li> <li>• with nitric acid more hydrogen ions in solution / greater concentration of hydrogen ions / hydrogen ions are more concentrated</li> <li>• with nitric acid more collisions (per second) between hydrogen ions and particles of calcium carbonate so faster reaction</li> </ul> <p><b>allow</b> ora for sulfamic acid but must specify which acid is being referred to</p>
	<b>Total</b>	<b>6</b>	

Question	Expected answers	Marks	Additional guidance
<b>11</b> <b>(a)</b> 	add two solutions and filter (1)  wash the residue with water (1)  dry the residue in an oven / leave in air to evaporate (1)	3	<p><b>ignore</b> sieving            filtering stage must be before the washing and drying stage</p> <p>washing stage must be before the drying stage</p> <p>drying stage must be the last stage  <b>allow</b> let it dry in air  <b>ignore</b> dry it / let it dry  <b>ignore</b> heat it</p> <p><b>not</b> use of a Bunsen burner to dry the residue</p> <p><b>allow</b> marks from a diagram            reaction mixture      water</p> 

Question	Expected answers	Marks	Additional guidance
(b)	<p>masses do not support the principle of conservation of mass because the difference in mass is significant / more evidence is needed / AW (1)</p> <p><b>OR</b></p> <p>masses support the principle of conservation of mass because the total mass of reactants is very close to total mass of products / the difference is due to experimental error/spillage/loss of product during filtering (1)</p> <p><b>WITH use calculation for second mark</b></p> <p>evidence of calculation of mass of reactants = 6.6g and mass of products = 6.4g used to support conclusion / difference in masses = 0.2g (1)</p>	2	to gain second mark numerical evidence must be used to support either conclusion
	<b>Total</b>	<b>5</b>	


Question		Expected answers	Marks	Additional guidance
12	(a)	20 – 50 °C (1) no oxygen (1)	2	<b>allow</b> must have water present
	(b)	hydration of ethene (1)	1	<b>allow</b> reacting ethene with steam <b>allow</b> hydrolysis of ethyl ethanoate
		<b>Total</b>	<b>3</b>	

Question		Expected answers	Marks	Additional guidance
13	(a)	oxygen and water (1)	1	<b>allow</b> O <sub>2</sub> and H <sub>2</sub> O <b>both</b> needed
	(b)	<b>any two from</b> use a layer of oil / grease the iron (1) paint over the iron (1) galvanising the iron / coating with zinc / coating with chromium (1) sacrificial protection / attach magnesium to iron (1) alloying / make stainless steel (1) tin plate / tinning (1)	2	<b>allow</b> chrome plating  <b>ignore</b> keep iron away from water or oxygen / keep it dry
		<b>Total</b>	<b>3</b>	

Question		Expected answers	Marks	Additional guidance
14	(a)	hydrogen (1)	1	allow H <sub>2</sub>
	(b)	because petrol engines make carbon dioxide / produce greenhouse gases / ora, but in a fuel cell water is the only waste product made which is not a pollutant (2)  <b>OR</b>  petrol engines make carbon dioxide/greenhouse gases / fuel cells make water (1)	2	<b>to gain 2 marks answers must include comparison of products from petrol engine and fuel cell</b>  assume answer refers to a fuel cell unless specified otherwise <b>allow</b> produce oxides of nitrogen for petrol engines <b>ignore</b> environmentally friendly / less damaging to environment / greener
		<b>Total</b>	<b>3</b>	

Question		Expected answers	Marks	Additional guidance
15	(a)	as a control / to see how much soap is needed to make a lather with pure water / water can only be hard if it needs more soap than distilled water (1)	1	
	(b)	boiled tap water (1)	1	<b>allow</b> other ways of indicating boiled tap water but answer on answer line takes precedence
	(c)	because boiled tap water needs less soap than un-boiled tap water it must contain temporary hardness (1) however, because boiled tap water still needs more soap than distilled water it still has hardness in it, so also contains permanent hardness (1)	2	<b>both marking points needed, in either order, for 2 marks, however either of the marking points alone scores 1 mark</b>
	(d)	calcium / magnesium (1)	1	<b>allow</b> correct response ticked or underlined
		<b>Total</b>	<b>5</b>	

Question		Expected answers	Marks	Additional guidance
16	(a)	<p><b>any three from</b>            used as a refrigerant:                because it is inert (1)                because it has a low boiling point / easily compressed into a liquid (1)</p> <p>used as a propellant:                because it does not burn / it is inert (1)                because it is insoluble in water (1)                because it is volatile (1)</p>	3	<b>properties must be linked to uses to gain credit</b>
	(b) (i)	(they agreed with scientists who told them) it causes ozone depletion (1)	1	<b>allow</b> scientists made them aware of the risks of ozone depletion
	(ii)	any year between 1988 and 1993 (1)	1	
		<b>Total</b>	<b>5</b>	

Question	Expected answers	Marks	Additional guidance
17 	<p><b>Level 3</b>            A comprehensive explanation which correctly recognises all the factors that change the time to collect the gas and link that to the evidence. Relationship between current and time quantified. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling.            (5-6 marks)</p> <p><b>Level 2</b>            A detailed explanation which recognises some factors that change the time to collect the gas and link that to the evidence. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling.            (3-4 marks)</p> <p><b>Level 1</b>            An attempt at an explanation which recognises some factors that change the time to collect the gas. No attempt to link to the evidence. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science.            (1-2 marks)</p> <p><b>Level 0</b>            Insufficient or irrelevant science. Answer not worthy of credit.            (0 marks)</p>	6	<p><b>Relevant points include:</b></p> <ul style="list-style-type: none"> <li>• concentration does not change time because no change in time with experiments 3 and 4</li> <li>• temperature does not change time because no change in time with experiments 1 and 2</li> <li>• current does change time because of the change of time in experiments 2, 3, and 4</li> <li>• as current increases the time decreases from experiments 2, 3, and 4</li> <li>• as the current doubles the time halves</li> </ul> <p><b>allow</b> higher level answer that current is inversely proportional to the time from experiments 2, 3, and 4  <b>allow</b> higher reference in terms of explanations eg as current increases more charge is passed, temperature and concentration do not change the charge passed  <b>allow</b> reference to the rate of electrolysis eg electrolysis is quicker as current increases, temperature and concentration do not change the speed of electrolysis</p> <p><b>ignore</b> reference to collision theory</p>
	<b>Total</b>	<b>6</b>	



Question		Expected answers	Marks	Additional guidance
18	(a)	1. cost of growing crops / price of crop / idea of making profit 2. suitability of climate / soil 3. impact on the environment 4. need for fertilisers / pesticides 5. need for new equipment	1	<b>two factors needed for 1 mark</b>
	(b)	(proportion of) energy lost / wasted / used in manufacture and growth is less / biodiesel is more efficient / bio-ethanol uses 40% of the energy produced in manufacture and growth(1)	1	
	(c)	hemp and 1500 (1)	1	<b>both needed for mark</b>
	(d) (i)	<b>any two from</b> idea that the trend is difficult to work out because there has been such a sudden rise (1) idea that it can be affected by other factors eg economics (1) availability of other fuels (1) changes in weather (1) or changes in government policies (1) better extraction techniques may be developed (1)	2	
	(ii)	food shortage / not enough food crops are grown (1)	1	<b>allow</b> over production and cannot sell the bio-diesel <b>allow</b> food prices increase <b>allow</b> less fossil fuels burnt / less carbon dioxide produced

Question	Expected answers	Marks	Additional guidance
(e)	<p><b>max 4 from:</b>  reasoning for type of bio-fuel (1)</p> <p>reasoning for type of plant (1)</p> <p>reasoning based on environmental /social issues (max 2)</p> <p>reasoning based on technology required (1)</p> <p>reasoning based on lack of information (max 2)</p>	4	<p><b>arguments must support decision to score</b>  eg she should grow crops for bio-diesel because it is more efficiently produced (1)</p> <p>eg she should grow hemp because she gets the biggest yield (1)</p> <p>eg she should grow crops for bio-fuels because it will reduce carbon dioxide emissions / will reduce global warming / reduce greenhouse effect (1) she should grow crops for bio-fuels because bio-fuels could be used instead of petrol in cars / can be burnt instead of fossil fuels (1)</p> <p>eg she should not grow crops for bio-fuels because she may use lots of fertiliser / pesticide / cause eutrophication (1) she should not grow crops bio-fuels because she should be growing food / people are in the world are starving / food is a better use of the land (1)</p> <p>eg she should not grow crops for bio-fuels because the technology is not ready yet / there are not enough cars that can use bio-fuels (1)</p> <p>eg she can not make a decision because she doesn't know about cost (1) she can not make a decision about plants because it depends on the conditions (on her farm) (1)</p>
	<b>Total</b>	<b>10</b>	